# Hedged Option Overlay on Fund

## Problem Statement

Develop an optimization tool designed to assist portfolio managers in selecting option types, strikes, and quantities for one or multiple legs while minimizing the tail risk, as measured by Conditional Value at Risk (CVaR)

## Mathematical Formulation

Given number of legs,

minimize CVAR1-alpha (L) over N, K, H such that

1. Price(N,K) / Fund AUM < c
2. Expected hedged returns/ Expected unhedged returns < rho

Where L is the portfolio value at t = T, alpha is the significance level of CVaR, N is a vector for the number of units of options in each leg, K is a vector for strikes for each leg and H is the fraction of portfolio to be hedged.

abs(N) are the number of units

Ni<0 signifies short and Ni>0 signifies long

abs(K) are the strikes

Ki<0 signifies Put and Ki>0 signifies Call

Price(N,K) is the total option premium spent to build the hedge

## Methodology

Step 1: Select a benchmark with a liquid options market and calculate covariance matrix and beta of the fund

Step 2: Between the available strikes fit a cubic spline to obtain a continuous option price function

Step 3: Simulate benchmark and fund over the holding period

Step 4: Run Sequential Least Squares Programming (SLSQP), which is a open-source non-linear optimizer

## Results

Strategy : Buy 91% Moneyness Put in benchmark – 3.5 units for every 1000 units of benchmark

|  |  |  |
| --- | --- | --- |
| Metric | Hedged Fund | Unhedged Fund |
| Annual Returns | 13.1% | 11.8% |
| Annual Standard Deviation | 19.8% | 15.9% |
| Sharpe Ratio | 0.46 | 0.74 |
| Calmar Ratio | 0.7 | 0.81 |
| CVaR | -27% | -9% |
| Cost of Hedge | 2.5% | 0% |

Code Repository : [GitHub](https://d.docs.live.net/520514892d605bb8/Desktop/One%20Pagers/Options%20Overlay.docx)

Calculate payoffs, fund values and CVaR

SLSQP Optimizer

## Input

Fund and Benchmark Simulated Values

Objective Function

Constraints

* Cost
* Expected Returns
* Bounds on Strikes

### Output

Optimal Type

Optimal Strike

Optimal Quantity

Optimal Hedge Ratio

Minimized CVaR